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# Worldwide Report

ENVIRONMENTAL QUALITY

No. 252

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# WORLDWIDE REPORT

## ENVIRONMENTAL QUALITY

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GUANGZHOU'S YUEXIU DISTRICT SOLVING POLLUTION PROBLEM

Beijing GUANGMING RIBAO in Chinese 14 Mar 80 p 1

[Article from Xinhuashe: "Initial Success in Environmental Protection Work in Guangzhou's Yuexiu District"]

[Text] Guangzhou's Yuexiu District has solved the problem of pollution from street industries through overall planning. As of the end of February, 18 plants and production cooperatives that seriously pollute the environment and cannot be brought under control at their present sites, have moved out of densely populated residential areas for the suburbs where they will carry out controls. Another eight are in process of moving. More than 10 more have adopted various methods through their own efforts to effect control locally and have already achieved definite results.

The Yuexiu District lies in the heart of Guangzhou and is the most densely inhabited area in the entire city. The 257 industrial plants, and communes operated by the streets here are engaged, for the most part, in the chemical industry, electroplating, spray painting, mechanical processing, forging, and casting, which pollute fairly seriously.

The quantity of airborne pollutants exceeds national standards by 100 percent. Numerous plants and communes willfully discharge the "three wastes" [waste gas, waste water, and industrial residue] and there is such a din and clatter that residents can get no peace. In recent years, demands by the masses to solve the pollution and the noise have become increasingly strong.

After the government promulgated the "(Trial) Environmental Protection Law" in September last year, the CCP Yuexiu District Committee in Guangzhou conducted a survey of the entire district. On the basis of the results of this survey, and following approval by higher authorities, it was decided that 18 plants and communes that were serious polluters and could not be brought under control in their present locations, should be moved to the suburbs during this year, after which controls would be instituted. Thirty-five plants and communes that cause a fairly large amount of pollution were told to implement full controls within a period of 2 years,

and if they could not effect full controls within the time allowed, they would be ordered to shut down. One hundred eleven plants and communes causing general pollution have to bring it under control within a year. Pertinent units in Guangzhou municipality have done overall planning for funds, facilities, materials, and work sites in active support of Yuexiu District's control of pollution.

The electroplating workshop of the Yuexiu automobile electrical equipment spare parts plant in Guangwei Street moved in December last year to a place in the suburbs where there is little smoke and few people. The municipal environmental protection office disbursed 3,000 yuan to help them add on a purifying device for their waste water. This will go into production at the end of March, and waste water will no longer pollute the environment once it has been processed in this purifier. The Yuehua Street Chemical Unit had produced printing ink in the courtyard of a residence, which was surrounded on three sides by dwellings and on one side by a primary school. When the plant mixed ingredients, all sorts of toxic powder flew all over the place. In December last year, this unit moved to the suburbs of the city to set up a plant and go into production. A bicycle spare parts plant and a forging shop, both of which made a great amount of noise, also moved out of congested residential areas into vacant land in the suburbs. Those able to bring pollution under control at existing sites, such as the mechanized plate glass manufacturing plant in Yuehua Street, which has installed exhaust conduits, and the Yuexiu No 2 Metal and Electric Equipment Plant, which has adopted measures such as high vacuum dilution of acid particles, have had fairly successful results.

Most recently, Yuexiu District further decided to emphasize development of non-polluting or only slightly polluting street industries such as light industries, and to make a major effort to develop processing and assembly industries for foreign trade, but not to set up casting, chemical, electroplating, or chemical plants that cause a great deal of pollution, or metal and machine plants that produce a lot of noise. Street industries must design pollution control devices as part of the main construction whenever they are building new plants, expanding plants or renovating plants, and these devices have to begin operation at the time the plants begin operation in order to prevent the production of further pollution.

9432

CSO: 5000

PEOPLE'S REPUBLIC OF CHINA

WATER POLLUTION BY CYANOGEN FROM SUZHOU CHEMICAL PLANT

Tokyo KYODO in English no time given 27 Mar 80 OW

[Text] Peking, 27 Mar (KYODO)--Twenty eight tons of water containing cyanogen, poison enough to kill some 48 million people, flowed out of a chemical plant into a canal in Suzhou near Shanghai last September, a Chinese newspaper said Wednesday.

The GONGREN DAILY said heavy damage was caused to fishery in the area but the paper did not mention whether there were any casualties due to the water pollution.

Suzhou with a population of 1.3 million was thrown into confusion following the accident before the poison evaporated or disintegrated a week later, the daily added.

It said the accident occurred when a factory worker at the chemical plant forgot to close a valve controlling the flow of cyanogen from a tank to another container.

Overflowing the container, the poison flowed into a canal near the plant and a total of 28 tons of contaminated water contaminated a wide area along the waterway, according to the paper.

It said the poison was enough to kill 48 million people, the entire population of Jiangsu Sheng Province in which Suzhou is located.

Suzhou, an old city, is also known for its numerous canals.

The daily said a local court has sentenced the factory worker, Zhang Changlin, to two years in prison and fined the plant 440,000 yuan (dollar 2.8 million).

The heavy penalty may indicate the accident caused some casualties.

CSO: 4020

## INTERNATIONAL AFFAIRS

### BRIEFS

CEMA ENVIRONMENTAL PROTECTION MEETING--The seventh plenipotentiary CEMA meeting for protection of the environment opened on Tuesday in one of the principal halls of the Public Health Ministry. Delegations from the Soviet Union, Poland, Hungary, Bulgaria, Czechoslovakia and the German Democratic Republic and representatives of Cuba and CEMA are participating in the meeting. Improvement and protection of the environment and work done over the past 5-year period in that sector will be examined at the meeting. Results of cooperation between CEMA member countries over the 1976-1979 period also will be examined. [Text] [FL01131 Havana Domestic Service in Spanish 1000 GMT 1 Apr 80 FL]

CS0: 5000



## NATIONAL AIR POLLUTION DANGER, CONTROL DESCRIBED

Warsaw WIADOMOSCI STATYSTYCZNE in Polish No 12, Dec 79 pp 7-12

[Article by Marian Grzesiak, Master of Engineering, Department of Agriculture and Food Economy, Central Bureau of Statistics: "Pollution and Environmental Protection in Poland--Air (II)"]

[Text] The first part of our article<sup>1</sup> described water resources and water pollution control. In this article we present the results of studies and statistical analyses from the field of environmental protection, containing statistical analyses from the field of environmental protection, containing problems of atmospheric air pollution and protection.

Atmospheric Air as the Subject of Statistical Studies of Environmental Protection

Because pollution of the atmosphere with noxious dust and gases is increasing, this problem has become one of the most essential in the complex of questions concerning environmental protection.

The share of industrial sources of pollution in Poland's balance of pollutants ranges from 60 to 70 percent. Another 10 to 15 percent of the pollutants are produced by means of transportation, about 9 percent of which by automobile transportation and service. The rest comprises steam traction of railroads, while the share of the means of water and air transportation in that balance remains thus far marginal. According to estimates, current emissions of individual community boiler rooms represent 15-20 percent of total emissions of air pollutants in our country.

Consequently, the main source of atmospheric pollution in Poland is industrial enterprises. Effective neutralization of the increasing atmospheric pollution does not keep up with the advancing industrial development, and threatens human environment with serious consequences. Apart from the fact that many valuable chemical compounds and rare metals are directly lost, emission of industrial air pollutants violates the basic law of biological balance between man and the nature around him,

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1. M. Grzesiak "Environmental Pollution and Protection in Poland"  
WIADOMOSCI STATYSTYCZNE No 11 1979.

which in turn threatens human health and environment. Moreover, the toxicity of industrial air pollutants is causing considerable losses in tree stands and crops. In addition, there are losses due to corrosion of steel constructions and plaster, higher wear of the machinery and gears, deterioration of clothes, losses in air and automobile transportation because of deteriorating visibility, losses of sunlight, and thus, increased usage of electric power for lighting.

In order to avoid or to mitigate the conflicts between man's industrial operations and nature, it is necessary to learn all specific sources, forms, and impact of the noxious effect of the industry, and to identify the mechanism of such phenomena and processes, their dynamics, as well as their direct and indirect effects.

On the basis of their knowledge of the actual situation of atmospheric air pollution, the state administration organs on central and local levels, responsible for the implementation of policies on environmental protection and development in our country, can make appropriate decisions and take remedial actions.

The information system of environmental protection statistics, organized and developed by the GUS [Central Bureau of Statistics] is seeking to meet such needs in accordance with the instructions stipulated in "Principles of the Program for Environmental Protection in Poland Prior to 1990," adopted by the Political Bureau of the Communist Party of the Polish United Workers Party and by the Council of State in 1975.

The following basic functions of that system were adopted in statistical studies of atmospheric air pollution and its control:

- Identification of the sources of atmospheric air pollution;
- Specification of the extent and the types of noxiousness of such sources;
- Determination of the existing potential in elimination or reduction of air pollution;
- Definition of the needs in the area of planned atmospheric air protection.

The share of individual groups of sources in total atmospheric air pollution in Poland was determined, and on that basis it was decided that in the first stage of conceptional and methodologic studies and in introductory works statistical characteristics will include industrial sources of emission.

In 1971, upon the initiative of the GUS and in agreement with the then Ministry of Local Economy and Environmental Protection, a permanent central system of annual reporting was established in industrial plants whose operations are known to be particularly harmful to clean air.

Those plants, consisting of nearly 1,000 units, were collectively identified and then checked over five-year periods by departments of provincial bureaus in charge of environmental protection. The same departments also evaluate the conformity and accuracy of statistical data reported by industrial plants. It is estimated that the selected plants discharge into the atmosphere more than 90 percent of all the dust and gases emitted by our industry. Annual reporting of those plants warrants the introduction of a system with the following typical indicators:

- The extent and type of emissions from noxious industrial plants (sources) polluting atmospheric air;
- Principles for the identification of emissions of air pollutants in the sources of emission;
- Classification of plants according to their noxious effect on the life of our population;
- Protective zones established for the protection of atmospheric air around the sources of emission;
- Employment and standard of qualification of air control specialists at noxious plants;
- The condition and structure of the equipment, and the effect of operations of facilities installed for control of atmospheric air pollutants.

This article describes the above-mentioned problems on the basis of the results of statistical studies for 1978. Certain data from the 1975-1977 period are offered for comparison and to illustrate the tendency and dynamism of the changes in terms of atmospheric air pollution and protection.

#### The Extent of Industrial Atmospheric Air Pollutants and Changes in Their Emission

In 1978 the emission from 931 industrial plants found to be dangerous to clean atmospheric air amounted to 2.5 million tons of dust pollutants, and to 4.5 million tons of gas pollutants. In comparison with 1975, the quantity of dust increased by 9.5 percent, and of gas by 11.5 percent. Here it must be stressed that the comparisons of the data on emissions in successive years were incomplete, which is apparent, among other things, from the fact that the methods of estimation were replaced by survey, and from the fact that the plants began accounting for new types of pollutants, and thus, the changes in the condition of their emissions were characterized by a special indicator "growth (+), decline (-)," determined in comparative conditions. This indicator unequivocally denotes deterioration or improvement in the situation in terms of danger to the atmosphere in the period under study.

As it appears from the data presented in Table 1, the 1975-1978 period was characterized by an unfavorable direction of changes in the amount of industrial pollutants discharged into the atmosphere. The rising

trends of total emissions concerned the dust as well as gaseous pollutants. As for dust, the increment in its emission was evident despite an obvious progress in the absolute extent of reduction of the pollutants. This means that the rate by which the protective potential has increased failed to keep up with the increasing quantities of pollutants from production flowlines in plants recently put into operation, due to intensified production in old production flowlines, to the deteriorating quality of fuel, improper utilization of purification stations, etc. As for gas pollutants whose neutralization, particularly in terms of sulphur dioxide, remains practically a moot question (a lack of economically warranted methods of desulfurization of fuels), the rate of increase in their emission has become even more evident.

In the context of such correlations it is important to consider that the "Principles of the Program for Environmental Protection in Poland Prior to 1990" envisaged continuous reduction of gaseous emissions from industrial sources during the 1975-1980 period. Moreover, in the 1975-1980 period the rate of increase in emissions of gas pollutants was higher than expected.

The degree of concentration of industrial pollutants in a specific area has a decisive effect on the development of the quality of the environment, and thus, on the health and life of the residents in that particular area. It is evident that the concentration of industrially harmful to clean air is reflected in the amount of the emitted dust and gases.

Table 1. Emission and Reduction of Industrial Pollutants of Atmospheric Air

(1) Specification	1975	1976	1977	1978
(2) Plants <sup>a</sup> polluting atmospheric air (situation as of 31 December), including plants with facilities for control of pollution caused by:				
dust				
gas				
(3) Emission of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				
(4) Reduction of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				
(5) Total emission of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				
(6) Total reduction of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				
(7) Net emission of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				
(8) Total emission of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				
(9) Total reduction of pollutants in thousand tons:				
Dust				
of which: fly ash				
metallurgical dust				
dust from cement works				

Table 1. Emission and Reduction of Industrial Pollutants of Atmospheric Air

Key:

1. Specification
2. Plants<sup>a</sup> polluting atmospheric air (situation as of 31 December), including plants with facilities for control of pollution caused by:
  - dust
  - gas
3. Emission of pollutants in thousand tons:
4. Dust
  - of which: fly ash
  - metallurgical dust
  - dust from cement works

[Key continued]

5. Gases  
    of which: sulfur dioxide
6. Pollutants captured in purification centers, in thousand tons:  
    Dust  
    Gases
7. Increase (+) or decrease (-) of emission of pollutants<sup>b</sup> in  
    thousand tons:  
        Dust  
        Gas
8. a - Plants emitting dust, gases, or both dust and gases;  
    b - Under conditions comparable with the preceding year.
9. Source: GUS data

Data in the table on the inside cover illustrate the threat to our country's atmosphere in a territorial framework according to individual provinces.

It appears that 74 percent of total emissions of dust and gas pollutants discharged by industrial plants into the atmosphere were concentrated in 1978 on the area of ten provinces. Successively, from the largest share in emission down, those were the following: Katowice (27.6 percent) the City of Cracow (14.3 percent), Legnica (7.3 percent), Jelenia Gora (7.2 percent), Opole (3.8 percent), Konin (3.7 percent), Szczecin (3.2 percent), the Capital City of Warsaw (2.5 percent), Bielsko-Biala (2.2 percent), and Radom (2.2 percent).

For planning and administrative purposes it is imperative to recognize the problem of air pollution and control in an organizational framework. Table 2 presents the characteristics of the range of basic information compiled for 1978 in a cross section of ministries.

The largest group of industrial sources of noxious emissions into the atmosphere consisted of plants subordinated to the Ministry of Construction and Construction Materials, then to the Ministry of the Chemical Industry, and to the Ministry of Food Industry and Purchases. On the other hand, the largest share in emissions of dust and gaseous pollutants was that of the plants subordinated to the following: the Ministry of Power Industry and Atomic Energy (39 percent), Ministry of Metallurgy (30.0 percent), Ministry of Chemical Industry (11 percent), Ministry of Construction and Construction Materials Industry (9 percent). Plants of the four above-mentioned ministries were responsible for 90 percent of the total industrial emission.



TABLE 2. ZAMIERZAJĄCYCH I OCIEPLAJĄCYCH PRZECIECZYŃSTWA

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Wyprawy i podróże	931	6917.4	1000	2480.0	4177.4	91.4	13.5	
(12) Ogółem	66	2709.6	39.1	1045.7	1664.1	94.2		
(13) Ministerstwo Energetyki i Energii Atomowej	82	233.4	3.3	129.4	96.0	84.7	1.1	
(14) Ministerstwo Galeonów	98	2017.3	29.5	134.2	1713.1	88.9	14.2	
(15) Ministerstwo Przemysłu i Handlu	95	100.8	1.5	35.6	64.8	71.5	0.4	
(16) Ministerstwo Przemysłu i Handlu	102	289.5	11.6	256.3	533.2	96.6	41.2	
(17) Ministerstwo Przemysłu i Handlu	59	46.9	0.7	18.3	29.6	72.1	3.9	
(18) Ministerstwo Przemysłu i Handlu	103	84.2	1.2	46.3	37.0	49.8	6.3	
(19) Ministerstwo Przemysłu i Handlu	85	81.3	1.2	39.9	41.4	75.2	1.0	
(20) Ministerstwo Przemysłu i Handlu	117	629.0	9.1	447.0	162.0	86.7	0.1	
(21) Ministerstwo Przemysłu i Handlu	48	130.3	1.9	46.9	83.4	77.9	4.6	
(22) Ministerstwo Przemysłu i Handlu	79	73.6	1.1	20.4	53.0	63.5	0.3	
(23) Ogółem								

**Table 2. Pollution and Protection of Atmospheric Air According to Individual Ministries in 1978**

**Key:**

- |     |  |     |   |
|-----|--|-----|---|
| 1.  | Specification                                | 12. | Ministry of Metallurgy                              |
| 2.  | No of polluting plants                       | 13. | Ministry of Machine Engineering Industry            |
| 3.  | Emission of pollutants                       | 14. | Ministry of Chemical Industry                       |
| 4.  | Total  | 15. | Ministry of Light Industry                          |
| 5.  | In thousand tons/year                        | 16. | Ministry of Food Industry and Purchases             |
| 6.  | In percents                                  | 17. | Ministry of Heavy and Agricultural Machine Industry |
| 7.  | Dust   | 18. | Ministry of Construction and Construction Materials |
| 8.  | Gas  | 19. | Ministry of Forestry and Timber Industry            |
| 9.  | Extent of reduction of pollutants            | 20. | Other   |
| 10. | Ministry of Power Industry and Atomic Energy | 21. | Source: GUS data                                    |
| 11. | Ministry of Mining                           |     |   |

## Differentiation of Sources of Noxious Industrial Emissions

When planning and implementing decisions concerning elimination or at least reduction of sources of noxious emissions, it is not inconsequential whether the total amount of emission consists of partial charges of approximate dimensions, or whether there is some differentiation in that respect, and to what extent, because those relations must determine the decisive procedures in environmental programs, and in particular, the terms of the necessary decisions, their sequence, urgency, costs, etc.





The data presented in Table 3 demonstrate considerable differentiations in the amount of emitted dust and gases, and thus, different levels to which individual plants pollute the air.

In 1978 among the 919 noxious industrial plants emitting dust pollutants, a group of 63 plants which determined the extent of atmospheric pollution each emitted more than 10,000 tons annually, and were responsible for 75 percent of total emissions of dust pollutants in our industry.

As for the emitted gas pollutants, it was made known that 65 particularly noxious plants emitted each more than 10,000 tons annually, i.e., 82 percent of total emissions of that atmospheric pollutant.

The analysis of noxious sources of industrial emissions presented here illustrates, among other things, the degree to which investment and modernization programs of atmospheric air protection, focused on large plants, may reduce atmospheric pollution from industrial sources.

#### Survey and Control of Atmospheric Air Pollutants

The law on protection of atmospheric air from pollution of 21 April 1966 (Official Gazette No 14, item 87) stipulated, among other things, that "plants emitting substances into free air must measure the concentrations of such substances during their discharge (emission) into the air on the premises of the plant as well as in protective zones." Statistical research supervises the implementation of that obligation.

As a matter of fact, as concerns the determination of the amount and types of pollutants by said industrial plants, the situation in general is unfavorable. For instance, in 1978 complete survey of the emitted dust was conducted by mere 37 percent, and of polluting gases by no more than 32 percent of the 931 plants under study.

In terms of control of the fallout of pollutants in areas around the plants and in protective zones, the situation appeared even less favorable. Moreover, half of the polluting plants failed to conduct any survey of that sort in 1978.

Survey of air pollution by industrial plants is but one part of the system of air pollution control and survey in our country. The actual situation there is as follows:

1. Organs of State Sanitary Inspection (PIS) survey fallouts of air pollutants in protective and highly protected areas, with the exception of closed areas (industrial plants and protective zones surrounding them). Although its range encompasses in theory the whole territory of our country, in practical application the PIS survey network contains several drawbacks, such as: application of non-uniform survey methods, inadequate and nonstandardized equipment, occasionally haphazard location of survey points, and considerable labor intensiveness of survey operations.

2. Centers of environmental research and control in provincial agencies conduct control measurements of the level of pollutants emitted into the atmosphere by industrial plants, as well as of their concentrations in the immediate vicinity of the sources of pollution. This survey serves as the basis for the specification of the type and amount of substances that may be discharged by industrial plants, and for the determination of sanctions against the plant, if it is confirmed by the survey that it has surpassed the permissible level of its emission.

3. Industrial services (plant laboratories) survey emissions and fallout in the area of the plant and in its designated protective zones. Despite the fact that at present more than 600 plants are obligated to conduct such survey, few of them actually comply; for example, in 1978, 116 plants failed to measure their dust emissions, and 184 plants failed to measure their gaseous emissions.

The air pollution control and survey system operating in the basis of the above-mentioned organizational principles is further characterized by diffused tasks and divided authority as well as responsibility. Furthermore, it is imperative to standardize the methods of survey and the equipment, to stipulate the principles of the flow, to relay the information and process the data.

In order to achieve full control and guidance in air protection for a specific area of our country, it is necessary to organize a survey network whose task it will be to register the existing condition, determine the trends of changes, sound alarm in emergencies, assist in the solution of crucial problems concerning reduction of pollution as well as the best possible identification of the sources of pollution. This task may be fulfilled by an automated survey network which will replace the currently applied system of conventional survey that is excessively laborious as well as imperfect, and that hinders prompt processing of the survey data.

#### Protective Zones and Identification of the Polluting Plant

In accordance with the legislation in force on atmospheric air protection (in particular, the decision of the Council of Ministers of 23 March 1976 --Official Gazette No 15, item 66) around plants emitting air-polluting substances in amounts higher than the permissible concentration, a protective zone must be designated and subsequently utilized.

Protective zone is an area separating industrial plants from the environment in which the concentration of the polluting substances must be diluted. The protective zone must be properly utilized, which means that appropriate vegetation, i.e., trees or shrubs, must be cultivated in that area. In addition, it cannot be used as construction site for buildings designated for permanent residence of the population and not directly connected with the production or services in the plant. Moreover, residential housing, nursery schools, kindergartens, boarding schools, etc., cannot be located within protective zones.

Protective zones fulfill various functions. Utilized zones may help improve the conditions of air pollution and favorably affect its spatial distribution in industrial areas and in the vicinity of the plant. Green belt barriers operate on the principle of screen, precipitating dust particles due to their inertia. The greenery absorbs dust, filters it and increases its turbulence. For instance, a 5-100 m screen reduces pollution by 50 percent, however, it does not capture the smallest particles of dust. Greenery may also absorb molecules of gas; for example needles of the spruce tree may absorb up to 38 percent of gas pollutants.

It must be stressed that protective zones have been recognized all over the world as factors in protection of the health of the population from chemical and physical pollution.

At the same time, from the data for 1978 it appears that 658 of the 931 plants included in the study did not have any protective zones at all. Among 273 plants with delineated protective zones, barely 80 described them as utilized.

Thus far, there has been a lack of norms and classifications of various industrial branches in terms of their location in relation to residential buildings. In general, it is recommended to keep the polluting industrial plants at a distance of more than 3 km from residential buildings.

A comparison of the above recommendation with the system of the plants under study confirmed that 81 percent of the plants were situated at a distance of less than 0.5 km from residential areas. Only 24 plants were located more than 2 km from human habitation.

Around many plants without protective zones woods take over that role. Our study indicates, among other things, that 90 percent of the polluting plants are located at a distance of less than 10 km from wooded areas.

Forests fulfill both a passive protective role in the fight against air pollution, because they reduce the access of dust and gases to protective zones by the isolating effect of dense tree stands, as well as an active protective role because they cut down the pollution by acting as filters of polluting dust, diluting the concentration of gases, and simultaneously, by absorbing them.

Retention of dust by tree stands varies according to the type and the species of the trees as well as according to the season. It has been confirmed that coniferous trees reduce air-polluting dust by approximately 30 percent, and deciduous trees by about 20 percent. For example, 1 hectare of spruce forest absorbs approximately 37 tons of dust, and pine forest 34.5 tons of dust.

However, forests can reduce air pollutants effectively only if their concentration does not surpass the threshold concentration, in other words, the concentration whose even extended action does not produce experimentally determined effects on the development and vegetation of the tree stand.

Unfortunately, the results of statistical studies demonstrate symptoms of negative effects of the action of atmospheric air pollutants have become evident in the vicinity of many industrial plants. As a result, forests are paying a high price for serving as protective environment of human habitation, because they cannot adapt to the changing conditions of growth and development due to the rapid of long-term effects of air pollutants.

The first stock-taking of woods within the area affected by industrial emissions was made in 1967. A comparison of its results with the GUS data in 1978 revealed that the deterioration in that area is characterized by a marked tendency of growth. Toward the end of 1978 the total wooded areas of the Ministry of Forestry and Timber Industry endangered by the noxious action of industrial pollution amounted to about 370,000 hectares. As compared with 1967, this means that the area of endangered forests has doubled: simultaneously, it is a self-evident example of unfavorable changes in atmospheric air pollution in our country.

#### Air-Control Facilities

Availability of purifying stations in plants, their operating efficiency, and the operating schedule (age) of such facilities determine, among other things, the opportunities to neutralize air pollution in sources of industrial emission.

From the data in Table 4 it is evident that in 1978 15 percent of the polluting plants lacked any type of dust collectors. However, the plants with such facilities differed considerably in operating efficiency, which was determined by the degree to which pollution was reduced. This is an indicator expressing in percents the ratio of the amount of the pollutants caught in the facilities to the amount of pollutants produced within the described time frame. The nearer the value of that indicator to 100 percent, the higher and more effective the operation of the protective potential available to the source of pollution, and thus, the lesser the threat to the clean air.





Facilities more than 90 percent efficient in reducing polluting dust were available in only 15 percent of the plants. It should be emphasized, however, that although the potential of dust collectors installed in industrial plants leave much to be desired, those facilities have "caught" a total of 25.8 tons of dust, which was 91.4 percent of the total amount of dust pollutants produced by our industry in 1978.

Considerably less favorable is the situation in terms of reduction of polluting gases. As mentioned before, the lack of practical (economically justified) methods of desulfurization of fuels is the reason why neutralization of polluting gases remains essentially an almost unapproached problem. In 1978 only less than 10 percent of the polluting plants had gas-neutralizing installations, most of them only on an experimental scale, or for specific types of pollutants. This is evident, among other things, from the fact that such facilities neutralized less than 0.7 million tons of pollutants, which is 13.5 percent of the total amount of the gases produced by our industry in 1978.

TABLE 5. WYPUSZCZENIE ZAKŁADÓW PRZEMYSŁOWYCH W URZĄDZENIA DO REDUKCJI  
ZANIECZYSZCZEN POWIETRZA ATMOSFERYCZNEGO W 1978 R.

(1)	Występowanie	(2)	Opis	(3)	Składnik eksploatacyjny	(7)	Obrotowy	(9)	100 lat 1. wojna
		(2)		(4)	(5)	(6)	(7)	(8)	(9)
Liczba urządzeń									
Cyklony (11)	(12)	5973	1597	2311	2065	1602	1621	1137	1613
Multicyklony (13)	(14)	903	201	516	186	380	196	116	211
Filtry tkaninowe (15)	(16)	3221	958	1573	690	725	660	651	1185
Elektrofiltry (17)	(18)	636	174	184	278	131	107	83	315
Urządzenia (19)	(20)	2481	680	1218	583	508	685	623	665
Pozostałe (21)	(22)	930				232	185	194	319
(17) Przepływ gazów odlotowych w mln m <sup>3</sup> /godz.									
Cyklony (11)	(12)	82,0	24,8	31,6	25,6	15,7	18,6	12,9	34,8
Multicyklony (13)	(14)	31,4	7,8	13,5	10,1	7,6	5,3	5,4	13,1
Filtry tkaninowe (15)	(16)	35,6	9,9	13,3	12,4	10,4	9,3	4,6	11,3
Elektrofiltry (17)	(18)	167,4	32,8	51,8	82,8	34,7	34,9	20,8	77,0
Urządzenia mokre (19)	(20)	41,3	13,0	18,7	9,6	7,9	10,7	11,2	11,5
Pozostałe (21)	(22)	13,2				2,1	1,1	3,9	6,1
Źródło: dane GUS (18)									

Table 5. Industrial Plants Furnished with Facilities for Reduction of Air Pollutants in 1978

Key:

1. Specifications
2. Total
3. Operating efficiency
4. Low
5. Average
6. High
7. Period of operation
8. 3 years or under
9. 10 years or more
10. No of facilities
11. Cyclone collectors
12. Multicyclone collectors
13. Cloth filters
14. Electric filters
15. Wet dust collectors
16. Other
17. Flow of waste gases in million cubic meters/hour
18. Source: GUS data



Table 5 presents data pertaining to specific structure of air control facilities installed in our industry according to the situation at the end of 1978, as well as to their efficient utilization and operating period. It appears that the indicator of the flow of exhaust gases in the unit of time is a more suitable characteristic of the protective potential than the number of the facilities. Only in surface analyses that particular characteristic may be based on the number of facilities.

Electric filters and cyclone collectors which play a decisive role in reducing emissions of industrial pollutants collected in 1978 about 70 percent of the potential flow of gases in all types of facilities. Under such circumstances it is unsatisfactory that 20 percent of the potential of electric filters and 30 percent of the cyclone collectors were installed in facilities with low operation efficiency. Even less favorable was the situation as regards the timetable for operations in the facilities. More than 45 percent of the electric filter potential were installed in "older" facilities operating for more than 10 years. The analogical indicator for cyclone collectors was 42 percent.

The situation concerning the availability of air control facilities in industrial plants, as well as the results achieved in the reduction of pollutants in the provincial network is illustrated in the table on the last page of the cover. The data in Table 2 deal with the same problems in the network of the ministries.

#### Services of Air Control and Supervision of Polluting Plants

If the air control facilities installed in industrial plants are to reduce pollution to a desirable degree, they must, among other things, be properly operated and maintained.

According to the needs, such conditions may be fulfilled by employing and organizing a staff composed of cadres with qualification necessary for the operation of such facilities.

TABLE 6. ZAKŁADY PRZEMYSŁOWE UCIAŻLIWE  
WEDŁUG ZATRUDNIENIA W OCHRONIE POWIETRZA W 1978 R.

(1)	Wyszczególnienie	Zakłady (2)	
		w liczbach bezwzględnych (3)	w odsetkach (4)
(5)	Ogółem . . . . .	931	100,0
(6)	Zakłady posiadające zatrudnionych		
(7)	w ochronie powietrza . . . . .	703	75,5
(8)	w tym inżynierów . . . . .	463	49,7
	1 osoba . . . . .	375	40,3
	2 . . . . .	59	6,3
	3 . . . . .	14	1,5
	4 . . . . .	4	0,4
(9)	5 osób i więcej . . . . .	11	1,2
(10)	Zakłady nie posiadające wcale zatrudnionych w ochronie powietrza . . . . .	228	24,5
(11)	Zakłady nie posiadające zatrudnionych inżynierów ochrony powietrza . . . . .	468	50,3
(12)	Źródło: dane GUS.		

Table 6. Noxious Plants According to Employment of Air Control Personnel in 1978

Key:

- |                                      |   |
|--------------------------------------|---|
| 1. Specification                     | 8. 1 person   |
| 2. Plants                            | 9. 5 or more persons  |
| 3. In absolute numbers               | 10. Plants without full-time employees in air control service |
| 4. In percents                       | 11. Plants without engineers employed in air control          |
| 5. Total                             | 12. Source: GUS data  |
| 6. Plants with air control personnel |   |
| 7. of whom engineers                 |   |

From the data in Table 6, which refer to 1978, it appears that the situation in the period under discussion was not advantageous.

Nearly 25 percent of the air-polluting plants lacked any air-control employees. More than a half of all the plants under study did not employ a single engineer with such specialization. If we allow for the plants where pollution control was assigned to one of the engineers as an extra duty, on top of his other basic tasks in the production, then the rate of such plants will be up to 90 percent. In that group were, among others, 47 "tycoon" plants producing annually over 10,000 tons of industrial pollutants.

It should be added that in some plants equipped with air control facilities their range was exceedingly modest. Quite frequently the individuals who had failed in other jobs were transferred to that department. In

many plants the air control employees were subordinated to the chief mechanic or chief power engineer, and as subordinates, they could not function efficiently.

This situation is disturbing. There is a growing number of plants where modern, expensive equipment has been installed; for instance, investment costs for air control increased from about 340 million in 1970 to about 1940 million in 1978 (in current prices). However, great many of these facilities are operating improperly and fail to achieve the planned reduction of pollutants (Table 5). One of the basic causes of that phenomenon is the lack of properly qualified cadres and an insufficient range of air-control facilities in individual plants.

Services of local environmental protection associated with departments for affairs of environmental protection in provincial bureaus as well as in research centers for environmental control (independent laboratories) supervise plants noxious to clean air. Operations of those services (in the new organization of local administration) have been processed statistically over a four-year period already, which gives us the right to confirm that they disclosed increasing atmospheric pollution caused by industrial plants, as may be documented, among other things, by the fact that 159 plants were fined in 1978 with a total of about 14.5 million for having exceeded their permissible emissions, as compared with 62 fines amounting to about 3.7 [million?] in 1975. As it appears from the analysis made since 1976, 20 plants are paying fines year after year.

Moreover, 19 complaints were brought in 1978 to the council for investigation of violations, and in 12 of those cases the council imposed fines for improper utilization of purification facilities. At the same time, penalties in the form of cash fines were imposed on physical persons responsible for the protection of the atmosphere in plants. In 1978 the imposed fines totaled about 62,700

The results of research and statistical studies presented here do not exhaust all the complicated problems of air pollution and protection in our country. Beyond their scope are emissions from means of transportation, especially automobiles, and emissions from residential incinerators. Such sources, particularly within urban centers, greatly intensify the unfavorable development of the phenomena of atmospheric pollution by our industry.

Those groups of sources are included in the statistical survey which depends to a considerable extent on the introduction of appropriate legal official regulations, basic documentation, and the introduction of a uniform network for the control and survey of air pollutants.

## NATIONAL WASTE POLLUTION, CONTROL DESCRIBED

Warsaw WIADOMOSCI STATYSTYCZNE in Polish No 2, Feb 80 pp 9-14

[Article by Marian Grzesiak, Master of Engineering, Department of Agriculture and Food Economy, Central Bureau of Statistics: "Pollution and Environmental Protection in Poland--Wastes (III)"]

[Text] Our preceding articles<sup>1</sup> presented the characteristics of water resources in conjunction with problems of pollution and of water pollution control, as well as the characteristics of pollution and air pollution control. In the present article we bring the results of research and statistically processed studies concerning problems of noxiousness of industrial and municipal wastes for the environment.

## Wastes as a Subject of Statistical Survey of Environmental Protection

Wastes represent one of the problems whose growth with the industrial development, advancing urbanization, the rise of the general living standard of our population not only leads to higher pollution of the environment but also poses serious problems in their solution.

Wastes stored over long periods are taking over increasingly larger areas of refuse dumps, piles, heaps, residual ponds, excavations left in claypits, and other places where they accumulate; wastes dumped illegally often litter the roadsides and forest areas. The large, constantly growing mass of wastes--particularly in recent decades which were characterized by an avalanche-like shift of natural resources--contaminates the air and is an eyesore in the landscape, because it encroaches upon cultivated agricultural and forest areas, pollutes waters and soil, upsets the balance of natural environment, and thus, endangers people's health and even life.

A characteristic trait setting that factor apart, in the territorial framework, from other threats to the environment (for example, sewage, emission of air pollutants) is the link of the generated charge of pollutants with a specific location. In the time frame the consequence

1. M. Grzesiak "Environmental Pollution and Protection in Poland" WIADOMOSCI STATYSTYCZNE Nos 11 and 12, 1979.

of that situation is the stockpiling of the released charged in a given area, and the resultant effect for the surrounding environment as well as for the population inhabiting that environment.

Statistical data from that field, based on regular reporting which has been initiated, most often concern municipal wastes. A pertinent information system is based on reporting on the operation of enterprises and purification stations designated for the needs of municipal economic managements. After certain modifications denoting changes in the process of control of such wastes (for instance, introduction of new methods of their neutralization), the range of that reporting may be very useful for the needs of statistical information in the field of environmental protection. A better system is needed also as regards principles, procedures and the extent of compilation of basic documentation on municipal wastes.

This problem is the topic of conceptual and preliminary studies conducted now by the Institute for Environmental Development within the framework of the subject "System of Basic Documentation on Environmental Protection for the Purposes of Management and Planning."

In terms of the problems of industrial wastes noxious to the environment or endangering it, the current situation of documentation of sources is fragmented and not uniform. The present documentary arrangement dealing with, and serving, the registration of even the same data and phenomena is characterized, as regards forms and contents, by considerable controversies in relation to the solution adopted by a given ministry of industrial subbranch. There are frequent instances where the economic subjects in general fail to document the mass of the produced wastes, and to register the data on the control of wastes.

In that situation the range of statistical information on industrial wastes, which functioned until 1974, considered exclusively the needs of material economy which is interested in that problem mainly from the point of view of actual utilization of wastes as secondary raw materials (substitutes). In those terms the information failed to provide adequate determination, and also in relation to several ministries it failed to meet fully parameters (indicators) facilitating the quantification of the effect of industrial wastes on the environment, or decisions concerning the elimination or reduction of their noxiousness.

In 1974, the GUS [Central Bureau of Statistics], the then Ministry of Local Management and Environmental Protection, and the Institute for Environmental Development launched a joint methodological program for the purpose of developing bases for quantification of problems of noxious effects on industrial wastes on the environment, and permanent inclusion of such problems in the statistical information system dealing with environmental pollution, protection, and development.



The final effect of that stage in the methodological studies was the introduction of continuous annual reporting on stockpiling, utilization and neutralization of nonmetallic industrial wastes polluting the environment. Moreover, in connection with the introduction of those problems in annual and five-year National Plans for Social Economic Development, the above-mentioned studies were expanded by problems of investment activities connected with utilization and neutralization of industrial wastes.

The statistical research in the period under discussion was conducted for the first time in 1975, and continued every year thereafter. The study includes all industrial plants producing annually 5,000 or more tons of wastes polluting the environment. The current criterion for the classification of the source (plant) as noxious was determined on the basis of the results of general registration conducted in 1974, which guaranteed the inclusion of continuous statistical study of all the sources producing jointly more than 95 percent of industrial wastes polluting the environment countrywide.

This kind of reporting provides an input of information describing the extent of the threat and of pollution by industrial wastes in the environment, and leads to decisions on counteractions to such phenomena.

We present below a synthesis of the results of the study under discussion for 1978. In order to demonstrate the dynamism of the changes as well as the trends of the development of the phenomena and processes described here, basic problems included in the period of the study are compared with the situation in 1975.

It should be emphasized that the data presented here are of an approximate character, and do not reflect the actual situation quite adequately, which is evident most of all from the already mentioned lack, or inadequate contents, of the documentary evidence, a lack of uniformity or definition in the methods of survey in terms of the calculated amounts of wastes, incorrect classification processing, very inferior collection of descriptive standards and parameters, as well as a low range of the problems under discussion in the management of economic units, which in turn affects the quality and accuracy of the reporting during that period.

#### General Characteristics of Sources Producing Industrial Wastes Noxious for the Environment

According to the situation toward the end of 1978, each of 563 individual plants in our country produced annually more than 5,000 tons of wastes polluting the environment. From the data presented in Table 1, however, it appears that not all plants in that system stockpiled the wastes they had produced directly on their own premises.

Tabl. 1. Zakłady przemysłowe wytwarzające rocznie powyżej 5 tys. ton odpadów uciążliwych dla środowiska

(1) Wyszczególnienie	1977			1978		
	(2) zakłady	(3) odpady nagromadzone		(2) zakłady	(3) odpady nagromadzone	
		w mln ton	w odsetkach		w mln ton	w odsetkach
(6) Ogółem	823	x	x	863	x	x
(7) w tym zakłady posiadające odpady nagromadzone*	318	643,6	100,0	360	822,1	100,0
(8) 5,0— 10,0 tys. t	50	9,1	0,0	34	0,1	0,0
10,1— 50,0 . .	61	1,6	0,2	50	1,5	0,2
50,1— 100,0 . .	34	2,4	0,4	33	3,8	0,5
100,1— 500,0 . .	48	12,4	1,8	70	15,4	1,9
500,1— 1000,0 . .	19	13,3	1,9	29	19,8	2,4
1000,1— 2000,0 . .	27	38,6	5,8	30	44,4	5,4
2000,1— 5000,0 . .	39	123,7	18,4	33	115,4	14,0
5000,1— 10000,0 . .	25	163,1	23,9	20	130,8	15,9
10000,1— 20000,0 . .	6	78,4	11,6	11	157,3	19,1
(9) 20000,1 tys. ton i więcej	9	248,0	36,2	10	333,6	40,6
(10) a) Na własnych terenach — stan w końcu roku.						
(11) b) Źródło: we wszystkich tabelach obliczenia GUS w oparciu o sprawozdania Ministerstwa Administracji, Gospodarki Stosownej i Ochrony Środowiska.						

Table 1. Industrial Plants Producing Annually More Than 5,000 Tons of Wastes Noxious for the Environment

Key:

1. Specification
2. Plants
3. Stockpiled wastes
4. In million tons
5. In percents
6. Total
7. Of which plants with stockpiled wastes<sup>a</sup>
8. 5.0 - 10.0 thousand tons
9. 20,000.1 thousand tons and more
10. a) On their own premises--situation at the end of the year
11. All tables present calculations by GUS based on reports of the Ministry of Administration, Local Economy and Environmental Protection

Some plants control the wastes they produced either by selling them, or turning them over to users, or by transferring wastes to storage dumps of other plants or to municipal dumps, and thus, they avoid their stockpiling on their own premises. Much more immediate effects on the environment were generated in 1978 by 360 industrial plants which jointly stockpiled about 820 million tons of wastes before the end of the period under study. A retrospective comparison of the number of sources and of the mass of wastes indicates a growing tendency of their noxiousness. From Table 1 it appears that individual noxiousness of the sources stockpiling their wastes is increasing, as confirmed by the numerical force of the plants in marginal sectors, and by the mass of wastes stockpiled on their premises in 1978 as compared with 1975.

The most efficient method of eliminating the wastes that pollute the environment is their utilization. This problem is best characterized by the indicator determined by the degree of recycled wastes, expressed in percents, to the total amount of wastes produced in one year. The most advantageous situation in terms of environmental protection occurs in that place where the indicator amounts to 100 percent, which means that all the wastes produced by that particular plant have been recycled. From the data for 1978 it is evident that only less than 30 percent of industrial plants that are considered as the main sources of environmental pollution have relatively well organized recycling of their wastes (the level of recycling above 93 percent).

In addition, the statistics warrant the generally held view that the extent of recycling of industrial wastes as secondary raw materials in our country has been insufficient; it is too low in view of the existing economic potential, and above all, it does not correspond with the needs to eliminate or reduce the threat to the ecology.

Various kinds of obstacles and drawbacks are heaped on the way to more extensive exploitation of wastes; in the main place among them are economic conditions, primarily a lack of adequate material economic incentives for recycling of wastes by those who produce them, as well as by their potential users. This is due mainly to the fact that when assessing the efficiency of enterprises, the principle criterion is the value of production, although it is known that the value of the raw materials used in production is also included in the value of production. It is axiomatic that this does not promote substitutions of more expensive raw materials with cheaper ones, including secondary materials.

Wastes (secondary raw materials) must be preferred if their utilization in a specific amount is cheaper both in the stage of investment as well as of production, and particularly, secondary raw materials that are more expensive than primary raw materials (for instance, phosphate anhydrites) must be used or utilized, otherwise we shall have to bear measurable and immeasurable costs in the form of environmental degradation caused by



their stockpiling. At present we are dealing in general with the evidently neglected introduction of comparative cost effectiveness of investment and production with and without the share of secondary raw materials.

Better exploitation of wastes is hampered also by legal and organizational obstacles. For instance, the question has not been unambiguously resolved as who should be in charge of recycling of wastes--those who produce them, or their future users, or perhaps a third party--for example, special enterprises for utilization and recovery of wastes.

A formidable obstacle to recycling is connected with the careless, non-selective stockpiling of wastes. At the same time, in particular the now unrecycled wastes require appropriate segregation, since it is quite probable that in the future they, too, may find some application, if they are properly preserved and treated as potential sources of secondary raw materials.

The danger to the environment caused by industrial wastes warrants the introduction of advanced programs for their neutralization in the actual situation.

It unambiguously follows from the data for 1978 that at present neutralization of industrial wastes in our country has left a marginal impact. Not quite 10 percent of sources have prepared any program in that direction. If one considers the "level of neutralization of wastes," or in other words, the ratio of neutralized wastes to the total amount of produced wastes, expressed in percents, then it is evident how little has been achieved thus far in that direction. For example, on the scale of the total mass of industrial wastes produced in 1978, barely 0.1 percent were neutralized, while in the course of such processes a declining trend is evident in absolute values in 1975-1978 (Table 4).

At the same time, technological solutions have been provided for the application of increasingly more radical and rational methods for neutralization of wastes.

Burning is one of the most efficient methods facilitating prompt elimination of certain kinds of wastes. Among the basic advantages of that method are primarily the following:

- A very high degree of reduction of the mass of wastes;
- As compared with the increasing scarcity of new waste storage areas, the construction of incinerators calls for relatively small surfaces;
- If furnished with dust collectors, incinerators may be located on the outskirts of residential areas. Such locations make it possible to avoid transfer of noxious wastes;
- Burning permits to utilize the heat generated by wastes in energy management.

Apart from burning, methods of recovery with a great future in enterprises dealing with neutralization of wastes permit, among other things, to recover numerous valuable elements from the wastes.

Since industrial wastes are recycled merely in some of the plants, and the enterprises specializing in their neutralization are in fact of marginal importance, the method of treatment of wastes applied thus far most often in our country is their storage in heaps, dumps, residual ponds, or in other areas designated for such purposes.

Storage of wastes must be regarded as the last resort and not as a rational method for disposal of inconvenient ballast. At the same time, from the data in Table 2 it follows that, among other things, 41.4 percent of the total mass of industrial wastes produced in 1978 were stockpiled

Many types of industrial wastes, particularly mineral wastes which at present are of no value as secondary raw materials must be stored in dumps which should be planned and used so as not to endanger the environment. It is therefore necessary to prevent any penetration of wastes deep into the layers of the soil by appropriate packing of the ground when storing the wastes, or by layer insulation. Furthermore, the topmost layer of the stored wastes must be sealed off from the atmosphere, so as to prevent any potential spreading of dust, or emission of noxious gases.

Tabl. 2. ODPADY PRZEMYSŁOWE NAGROMADZONE I WYKORZYSTANE

(1) Wykaz odpadów	(2) Opatrzono na składowanie w tym: gromadzonych w latach			(4) Opatrzono na wyzyskanie w tym: w latach			(5) W tym: w roku 1978 odpowiednie odpady		
	1973	1978	1973 - 1978	1973	1978	1973 - 1978	1973 - 1978	1978	1973 - 1978
	(3) w mln ton			(3) w mln ton			(6)	(7)	(8)
(9) Ogółem w tym odpady (10)	683,6	822,1	138,5	136,2	161,4	27,2	58,5	0,1	41,4
(11) Pochłapczyne	169,1	207,2	38,1	20,9	24,7	3,8	3,9	—	96,1
(12) Popioły i pyły	55,1	68,6	13,5	13,0	17,0	4,0	32,1	0,1	67,8
(13) Inne	89,5	87,5	-2,0	15,6	19,2	3,6	63,0	—	37,9
(14) Składowe	282,1	344,2	62,1	70,5	82,1	11,6	87,2	—	12,8
(15) Podlegające	12,2	20,9	8,7	2,8	2,9	0,1	0,8	—	95,2
(16) Podlegające	27,5	30,0	2,5	1,3	1,2	-0,1	4,6	0,1	95,3

(17) a) Na składowanie i przetwarzanie w tym: w składowiskach odpadów, b) Kolorowa i galwanizacja z kromieniem i cynkiem i stal oraz przetworzone metale i ceramika.

Table 2. Stockpiled and Produced Industrial Wastes

Key:

1. Specification
2. Wastes stockpiled on the premises of industrial plants (situation at the end of the year)
3. In million tons
4. Wastes produced during the year
5. Among them, rate of wastes in 1978
6. Recycled
7. Neutralized
8. Stockpiled<sup>a</sup>
9. Total
10. Of which wastes:
11. Post-flotation
12. Ashes and dust
13. Slag
14. Stone
15. Phosphate anhydrite
16. Post-distillation  
a - Private and public dumps, heaps, and alluvial ponds above and below the surface;  
b - Boiler and furnace slag from ferrous and steel metallurgy, and from non-ferrous metallurgical industry.
- 17.

From the above data it follows, first of all, that the mass of industrial wastes stockpiled thus far in the environment has grown to gigantic proportions, exceeding 820 million tons at the end of 1978. Simultaneously, we are dealing with a phenomenon of constantly increasing charge of waste encumbering our environment, for instance, in 1975-1978 by 20 percent. This is due to the fact that more than 41 percent of the "annual production" of wastes, which in 1978 surpassed 160 million tons (not including the overburden from strip mines), were stored.

Rock wastes have the decisive quantitative share among the wastes stockpiled thus far in the environment (about 42 percent). With the intensive development of the mining industry in Poland, the mass of wastes accompanying such programs is growing rapidly (for instance, from 71 million tons in 1975 to about 82 million tons in 1978). An encouraging phenomenon in terms of that group of wastes is the progress in their recycling. For example, in 1978 that process involved more than 87 percent of the total amount of produced rock wastes (in 1975, 74 percent).

Post-flotation wastes produced mainly during processes for enrichment of copper, sulphur and galena ores have a considerable share among the wastes accumulated thus far (25 percent). Because an insignificant amount of such wastes is being recycled (less than 5 percent of their annual production), the mass of the charges encumbering our environment has been growing rapidly (annual increment about 24 million tons).

Slags form another large mass of the stockpiled wastes (totaling about 11 percent). This group of wastes systematically adds to the encumbrance of our environment, because they are recycled to a degree slightly in excess of one half of the amount of such wastes produced at present. Unfortunately, although such options are available, they are not being properly utilized, and consequently, the storage of wastes negatively affects sanitary conditions of the environment, as evident from the results of local laboratory inspection conducted by the services of the State Sanitary Inspectorate. Pertinent data from 1978 demonstrate, for example, that among the inspected waste storage on municipal territory up to 38 percent were classified as unsanitary, and that ratio was even higher on the territory of villages, amounting to 43 percent.

#### Structural Types of Industrial Wastes

Data in Table 2 present the total amount of industrial wastes stockpiled thus far by the above-mentioned sources recognized as particularly noxious for the environment (plants producing annually more than 5,000 tons of wastes). Moreover, the table presents structural types as well as the characteristics of processing of the principal types of wastes produced during the 1975-1978 period.

Toward the end of 1978 ashes and dust constituted more than 8 percent of the stockpiled wastes. Wastes from public utility and industrial power stations have a lion's share in that amount. Also, that group is rapidly expanding its share in the charge encumbering the environment, particularly because nearly 70 percent of the annually produced mass is stored.

Among other wastes which in terms of quantity represent a certain encumbrance for the environment, noteworthy are the types that are stockpiled almost in their entirety. The stockpiles of phosphate anhydrites, 99 percent of which is stored, are approaching 21 million tons. Post-distillation wastes from the production of soda which are stored to an analogical degree (91 percent) amounted to more than 29 million tons toward the end of 1978. The high indicator of stockpiling is typical also for flowage soil (95 percent), lime sludge waste (97 percent), and wastes from sewage treatment plants (74 percent).

#### Characteristics of Noxiousness of Industrial Wastes

In 1978 all of industrial plants selected on the basis of the criterion classifying them as sources of environmental pollution (organisational units producing more than 5,000 tons of wastes annually) were subordinated to 11 economic ministries.

Table 3 offers data which characterize those ministries according to the number of waste-producing sources (plants), the amount of the hitherto stockpiled wastes, and also the extent of the annual "production" of wastes in individual ministries, with the specification of the amount of recycled and stored wastes.

TABLE 3. ZARŁADY PRZEMYSŁOWE WYTWARZAJĄCE RÓCZNIE POWYZEJ 5 TYS. TON ODPADÓW UCZĄSZĄCYCH  
DLA ŚRODOWISKA WEDŁUG REZULTATÓW W 1978 R.

(1) Rozorty	(3) Odpady				
	(2) Liczba zakładów	(4) ogółem <sup>a</sup>		(5) wydzielone w ciągu roku	
		(6) w mln ton	(7) w odset- kach	(8) w mln ton	(9) w odset- kach
				(10) w mln ton	(11) w odset- kach
(12) <b>Północ</b>					
(14) Min. Energetyki i Energii Atomowej (13)	563	822,1	100,0	161,4	66,8
(15) Min. Górnictwa	60	66,2	8,1	17,6	12,2
(16) Min. Hutnictwa (15)	74	257,0	31,3	76,9	7,3
(17) Min. Przemysłu Maszynowego (16)	51	332,1	40,4	41,5	29,4
(18) Min. Przemysłu Chemicznego	43	1,5	0,2	1,3	0,5
(19) Min. Przemysłu Lekkiego (18)	72	106,9	13,0	9,6	7,8
(20) Min. Przemysłu Spożywczego i Skupu (19)	45	0,4	0,0	1,1	0,5
(21) Min. Przemysłu Maszyn Ciężkich i Rolniczych	85	9,1	1,1	5,5	0,6
(22) Min. Budownictwa i Przemysłu Materiałów Budow- lanych	37	2,0	0,2	1,5	0,7
(23) Min. Leśnictwa i Przemysłu Drzewnego (22)	22	2,8	0,3	0,9	0,6
(24) Min. Komunikacji	42	2,2	0,3	1,2	0,2
	32	41,9	5,1	4,3	2,6
(25) <b>Wschód</b>					
(26) Min. Energetyki i Energii Atomowej (25)	563	822,1	100,0	161,4	66,8
(27) Min. Górnictwa	60	66,2	8,1	17,6	12,2
(28) Min. Hutnictwa (27)	74	257,0	31,3	76,9	7,3
(29) Min. Przemysłu Maszynowego (28)	51	332,1	40,4	41,5	29,4
(30) Min. Przemysłu Chemicznego	43	1,5	0,2	1,3	0,5
(31) Min. Przemysłu Lekkiego (30)	72	106,9	13,0	9,6	7,8
(32) Min. Przemysłu Spożywczego i Skupu (31)	45	0,4	0,0	1,1	0,5
(33) Min. Przemysłu Maszyn Ciężkich i Rolniczych	85	9,1	1,1	5,5	0,6
(34) Min. Budownictwa i Przemysłu Materiałów Budow- lanych	37	2,0	0,2	1,5	0,7
(35) Min. Leśnictwa i Przemysłu Drzewnego (34)	22	2,8	0,3	0,9	0,6
(36) Min. Komunikacji	42	2,2	0,3	1,2	0,2
	32	41,9	5,1	4,3	2,6

Table 3. Industrial Plants Producing Over 5,000 Tons of Wastes Noxious for the Environment  
According to the Ministries in 1978

Key:

1. Ministries
2. No of plants
3. Wastes
4. Stockpiled<sup>a</sup>
5. Produced within one year
6. In million tons
7. In percent
8. Of which
9. Together
10. Recycled<sup>b</sup>
11. Stored<sup>c</sup>
12. Total
13. Ministry of Power Industry
14. Ministry of Mining
15. Ministry of Metallurgy
16. Ministry of Machine Engineering
17. Ministry of Chemical Industry
18. Ministry of Light Industry

[Key continued]

19. Ministry of Food Industry and Purchases
20. Ministry of Heavy and Agricultural Machine Industry
21. Ministry of Construction and Construction Material Industry
22. Ministry of Forestry and Timber Industry
23. Ministry of Communications
24. a - In their own dumps and alluvial--onds--situation at the end of the year;  
b - Together with wastes utilized in landfill as well as in construction and road-engineering works.  
c - In private and communal surface and underground dumps, piles and alluvial ponds.

It appears that the share of individual ministries in polluting the environment with wastes is considerably differentiated. This may be confirmed by the fact that 98 percent of the wastes stockpiled before the end of 1978 in heaps, dumps, alluvial ponds, and other local storage areas were concentrated in 5 ministries, among which the Ministry of Metallurgy (40 percent) and the Ministry of Mining (31 percent) held a dominant place.

The Ministry of Mining was responsible for exactly one half of the total amount of wastes produced during 1978. Most wastes from the current production of wastes were stored by the following ministries: Ministry of Metallurgy (44 percent), Ministry of Power Industry (18 percent), Ministry of Chemical Industry (12 percent), Ministry of Mining (11 percent).

The scale of noxiousness produced in a given ministry, branch or in a specific industrial plant is not determined only by the absolute mass of the wastes discharged into the environment. No less important is the structure of their type, which consists of a complex of morphologic, physical, chemical and biological characteristics determining the potential individual noxiousness of the wastes in relation to the environment. A general illustration of that problem in the group of individual ministries is presented in the data of Table 4.



TABLE 4. STRUKTURA RODZAJOWA ODPADÓW NAGROMADZONYCH WEDŁUG RESORTÓW 1978 r.

Stany w bilansie roku

(1) Rodzaj	(2) Stan w bilansie roku							
	Odpady dotychczas nagromadzone dotychczas składowane w stacjach naftowych i innych	(3) Odpady dotychczas nagromadzone dotychczas składowane	(4) Pozostałości	(5) Zużycie*	(6) Fakto-ry	(7) Odpady dotych-czasne	(8) Odpady dotych-czasne	(9) Pozostałości
(11) Ogółem	822,1	25,2	8,3	10,6	2,5	41,9	3,6	7,9
(12) Min. Energetyki i Energii Atomowej	66,2	—	81,4	18,5	—	—	—	0,1
(13) Min. Górnictwa	257,0	3,3	1,3	0,6	—	94,1	—	0,7
(14) Min. Hutnictwa	332,1	51,6	0,3	20,2	—	17,9	—	10,0
(15) Min. Przemysłu Chemicznego	106,9	25,4	8,6	5,0	19,5	0,9	28,0	12,6
(16) Min. Komunikacji	41,9	—	—	—	—	100,0	—	—
(17) Pozostałe*	18,0	—	6,4	8,3	—	—	—	85,3

(\*) Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. c. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. d. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. e. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. f. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. g. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. h. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. i. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. j. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. k. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. l. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. m. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. n. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. o. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. p. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. q. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. r. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. s. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. t. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. u. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. v. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. w. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. x. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. y. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. z. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. aa. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ab. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ac. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ad. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ae. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. af. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ag. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ah. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ai. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. aj. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ak. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. al. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. am. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. an. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ao. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ap. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. aq. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ar. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. as. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. at. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. au. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. av. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. aw. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ax. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ay. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. az. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ba. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bb. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bc. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bd. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. be. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bf. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bg. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bh. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bi. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bj. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bk. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bl. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bm. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bn. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bo. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bp. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bq. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. br. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bs. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bt. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bu. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bv. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bw. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bx. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. by. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. bz. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ca. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. cb. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. cc. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. cd. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ce. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. cf. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. cg. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ch. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ci. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. cj. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. 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Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ds. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. dt. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. du. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. dv. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. dw. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. dx. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. dy. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. dz. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ea. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. eb. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ec. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ed. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ee. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ef. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. eg. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. eh. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ei. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ej. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ek. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. el. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. em. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. en. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. eo. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ep. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. eq. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. er. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. es. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. et. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. eu. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ev. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ew. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ex. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ey. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. 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Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ga. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gb. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gc. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gd. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ge. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gf. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gh. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gi. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gj. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gk. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gl. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gm. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gn. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. go. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gp. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gq. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gr. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gs. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gt. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gu. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gv. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gw. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gx. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gy. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. gz. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. ha. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hb. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hc. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hd. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. he. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hf. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hg. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hh. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hi. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hj. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hk. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hl. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hm. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych. b. Minierowa: Przemysłu Maszynowego. Leżące, Spółdzielczo i Strop, Maszyn. hn. Kodowo i jednolite, z hutnictwa i stali oraz metali szlachetnych

(18) a - Koksownicze i paleniskowe, z koksowniczymi i innymi odpadami metalnymi; b - Ministerstwa: Przemysłu Maszynowego, Lotnictwa, Spółdzielczości i Skupu, Maszyn i Urządzeń, Rolnictwa, Budownictwa i Przemysłu Materiałów Budowlanych oraz Lotnictwa i Przemysłu Drzewnego.

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Table 4. Structure of Types of Wastes Stockpiled According to Ministries in 1978. Situation at the End of the Year.

Key:

1. Ministries
  2. Wastes hitherto stockpiled in plant heaps and alluvial ponds in million tons
  3. Post-flotation wastes
  4. Ashes and dust
  5. Slag<sup>a</sup>
  6. Phosphate anhydrite
  7. Rock waste
  8. Post-distillation wastes
  9. Other
  10. In percent
  11. Total
  12. Ministry of Power Industry and Atomic Energy
13. Ministry of Mining
  14. Ministry of Metallurgy
  15. Ministry of Chemical Industry
  16. Ministry of Communications
  17. Other<sup>b</sup>
  18. a - Boiler and furnace slag, from ferrous and steel metallurgy, and from non-ferrous metallurgy.  
b - Ministries of: Machine Engineering Industry; Light Industry; Food and Purchases; Heavy and Agricultural Machinery; Construction and Construction Material Industry, and Forestry and Timber Industry.



The wastes stockpiled by industrial plants subordinated to the Ministry of Chemical Industry are characterized by the most varied types of structure. Among other things, wastes that are extremely noxious for the environment, such as post-flotation wastes (particularly those from the production of sulphur), phosphate anhydrite, or post-distillation wastes, are concentrated in that ministry. Plants of the Ministry of Power Engineering and Atomic Energy discharge into the environment mostly ashes and dust (81 percent) and slag (19 percent). Plants of the Ministry of Mining, and of the Ministry of Communications produce mainly rock wastes. Metallurgy encumbers the environment primarily with post-flotation wastes (32 percent), slag (20 percent), and rock wastes (18 percent).

#### Concentration of Industrial Wastes

When analysing the phenomenon of the concentration of industrial wastes in the environment, two aspects of that problem were of prime consideration.

The first one concerns their territorial deployment. The degree of the concentration of pollutants in a specific area decisively affects the development of environmental quality and thus, the conditions of life and health in that area.

Noxiousness of industrial wastes in a territorial frame is characterized by considerable differentiation. According to the total charge of wastes stockpiled in the environment at the end of 1978, individual provinces may be divided into the following groups:

- Group I - Provinces on whose territory no storage of industrial wastes from sources according to the accepted criterion of classification has been recorded: Biala Podlaska, Koszalin.
- Group II - Provinces with up to 100,000 tons of stockpiled wastes: Ciechanow, Lomza, Pila, Rzeszow, Siedlce, Skierniewice, Slupsk, Suwalki;
- Group III - Provinces with 100,000 to 300,000 tons of stockpiled wastes: Bialystok, Chelm, Kalisz, Olsztyn, Poznan, Przemysl, Torun, and Wroclaw.
- Group IV - Provinces with 300,000 to 1 million tons of stockpiled wastes: Elblag, Gorzow Wielkopolski, Krosno, Leszno, City of Lodz, Piotrkow, Sieradz, Zielona Gora;
- Group V - Provinces with 1 to 3 million tons of stockpiled wastes: Capital City of Warsaw, Lublin, Ostroda, Plock, Tarnow, Zamosc;
- Group VI - Provinces with 3 to 10 million tons of stockpiled wastes: Bielsko-Biala, Gdansk, Jelenia Gora, Radom, Wroclaw;

Group VII - Provinces with over 10 million tons of stockpiled wastes:  
Bydgoszcz (29), Częstochowa (41), Katowice (335), Kielce (14),  
Konin (19), City of Cracow (39), Legnica (147), Opole (14),  
Poznań (19), Tarnobrzeg (30), Wałbrzych (54).

Group VII deserves special attention when analysing the phenomenon of territorial concentration of wastes in terms of provincial averages. The provinces in that group were subject to an analysis of structural types of the stockpiled wastes (Table 5).

TABLE 5. STRUKTURA RODZAJOWA ODPADÓW PRZEMYSŁOWYCH W WŁĘKOWOŚCIACH O WYSOKIEJ KONCENTRACJI  
ODPADÓW NAGROMADZONYCH W 1978 R.

(1)	Węzłowość	Składowiska odpadów						
		(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Odpady dotychczas magazynowane na składowiskach w stacjach odwodnienia w składowiskach	Odpady dotychczas magazynowane na składowiskach w stacjach odwodnienia w składowiskach	Procent w składowiskach	Zużycie <sup>a</sup>	Procent w składowiskach	Odpady dotychczas magazynowane	Odpady dotychczas magazynowane
Polska	(11)	822,1	25,3	8,3	10,6	2,5	41,9	3,6
Bydgoszcz	(12)	29,5	—	2,9	2,8	—	—	87,2
Częstochowa	(13)	40,5	3,4	0,4	2,8	—	84,2	—
Katowice	(14)	334,7	12,9	5,4	12,2	—	65,8	0,0
Kielce	(15)	13,9	0,2	—	8,6	—	76,1	—
Konin	(16)	19,4	—	87,0	11,5	—	—	—
Miejskie Krakowskie	(17)	50,5	—	1,6	43,6	—	3,5	—
Legnica	(18)	147,4	87,9	0,0	3,8	—	7,7	—
Nowosądeckie	(19)	11,3	—	—	—	—	99,1	—
Opolskie	(20)	14,5	—	59,5	15,1	—	2,6	—
Szczecińskie	(21)	18,7	—	18,4	3,6	72,8	—	—
Tarnobrzęskie	(22)	30,2	89,1	6,8	1,7	—	—	—
Wałbrzyńskie	(23)	54,5	10,5	5,0	3,9	—	78,0	—
Pozostałe	(9)	57,0	—	28,2	10,6	12,8	20,3	0,1

a Kodowa: 1 - drewno, 2 - koks, 3 - ropa, 4 - olej, 5 - gaz, 6 - węgiel, 7 - żelazo, 8 - miedź, 9 - pozostałe.

Table 5. Structural Types of Industrial Wastes in Provinces with High Concentrations of Stockpiled Wastes in 1978.

Situation at the End of the Year.

Key:

1. Provinces
2. Wastes stockpiled thus far in plant dumps and alluvial ponds, in million tons
3. Post-flotation wastes
4. Ashes and dust
5. Slag<sup>a</sup>
6. Phosphate anhydrite
7. Rock wastes
8. Post-distillation wastes
9. Other
10. In percent
11. Poland
12. Bydgoszcz
13. Częstochowa
14. Katowice
15. Kielce
16. Konin
17. City of Cracow

[Key continued]

18. Legnica
19. Nowy Sacz
20. Opole
21. Szczecin
22. Tarnobrzeg
23. Walbrzych
24. a - Boiler and furnace slag, from ferrous and steel metallurgy  
and from non-ferrous metallurgy

From the above data it appears that up to 93 percent of the total amount of wastes were concentrated in 12 provinces; on the territory of each of them the amount of the stockpiled industrial wastes exceeded 10 million tons at the end of 1978. Almost half of all industrial wastes stockpiled thus far in all of Poland was concentrated in the province of Katowice alone. Furthermore, the data in Table 5 illustrate the fact that apart from quantitative differentiation, we have to deal, in the territorial frame, with considerable differentiation of the structure of the types of stockpiled wastes. Thus, for example post-flotation wastes are typical environmental pollutants in the provinces of Legnica, Katowice and Tarnobrzeg. Ashes and dust are concentrated mainly in the provinces of Konin, Katowice and Opole. Rock debris holds the main share in the provinces of Czestochowa, Katowice, Kielce, Nowy Sacz and Walbrzych. Phosphate anhydrite wastes are typical for the province of Szczecin, and post-distillation wastes for the province of Bydgoszcz.

Noxiousness of individual sources of produced wastes is another aspect, because it is of importance whether partial charges of sources of approximate dimensions share in the total charge of industrial wastes discharged in the environment, or whether there is some difference in their dimensions, and if so, how large. Accordingly, waste producing sources (plants) affect the environment in different ways and counteractions of their noxiousness must be approached with corresponding differentiation.

From the data presented in Table 1 it appears that noxiousness of individual plants, expressed by the parameter of the wastes stockpiled thus far, was characterized by enormous differentiation. It should be stressed that according to the situation at the end of 1978, 256 units among 360 industrial plants which stockpiled wastes on their premises collected barely 4 percent of the mass of wastes stockpiled countrywide.

In this situation a group of 104 plants which determined the dimensions of quantitative environmental pollution with wastes stockpiled at least one million tons of wastes each. Those units accumulated jointly 96 percent of the charge of industrial wastes stockpiled thus far in the environment. Further differentiation of individual concentration of wastes on the premises of that group of sources of stockpiled wastes must be pointed out with special attention to a group of 21 plants, the "waste factories," each of which stockpiled in various storage areas

more than 10 million tons of wastes. A total of 60 percent of the mass of industrial wastes stockpiled in the environment before the end of 1978 was concentrated in those plants.

#### Communal Wastes

Communal wastes produced by households as well as by hospitals, schools, food catering, trade, commerce, agencies, etc., represent a potential source of threat to healthy environment.

Said "producers" disposed about 33 million cubic meters of communal wastes during 1978 (as compared with approximately 25 million tons in 1975) and dumped them on a total area of about 2,200 hectares. Those data do not include private, "illegal" dumps generally on small areas. As concerns their condition, many of the existing dumps flagrantly violate regulations of environmental protection.

Their occupation of more and more new areas with increasingly more perceptible losses of agricultural lands and forests is but one of the harsh consequences of stockpiling of communal wastes in dumps. Other untoward effects accompanying those phenomena are their unsuitable locations and contamination of surface waters, and in case of permeable ground, also of underground waters. Untreated open dumps which we encounter most frequently pollute the air with dust blown off from their dried-out surface, as well as with noxious gases which often develop in the process of self-decomposition of the wastes. Such dumps are also freely accessible to rodents, birds and insects that transfer bacteria and viruses, for example, of household and hospital origin, present in the wastes.

One of the most rational methods of neutralization of communal wastes is composting, which reduces their mass as well as produces valuable organic fertilizers. Agricultural exploitation of fertilizers not only is not developed in our country at present, but it was observed in recent years that the application of that method had declined. For instance, 7 composting plants operating in 1973 processed about 250,000 cubic meters of wastes, i. e., 1.6 percent of their annual accumulation. In 1978, only 87,000 cubic meters of communal wastes were neutralized in 6 composting plants, which amounts to 0.3 percent of their annual accumulation.

Burning of communal wastes is a method of their neutralization used with increasing frequency in the developed countries and regarded as the most effective one in terms of environmental protection, but in our country it is in the realm of future plans. The "Principles of the Program for Environmental Protection in Poland Prior to 1990" envisaged, among other things, the introduction of an experimental incinerator for communal wastes, and then generalization of results thus obtained in thermal methods of neutralization of wastes.

The results of statistical studies presented here do not deal with every problem of pollution and with every program for reduction of the extent of environmental pollution caused by wastes. The directions of the socio-economic development in our country demonstrate the need to consider new sources and types of wastes. Thus, for example, the concentration of animal production is followed by environmental pollution with agricultural wastes, the development of automobile transportation with the problem of derelict cars, and chemicalization with the problem of removal and accumulation of plastic containers.

Thus, the process of creation of methodological bases and introduction of a comprehensive system of statistical data for the purposes of protection of the environment from noxious wastes must be regarded as barely started and in need of further improvement and development.

9004

CSO: 3000

## ANTIPOLLUTION MEASURES AT CEMENT WORKS

Amman AL-RA'Y in Arabic 27 Mar 80 p 3

[Article: "Instruments for Measuring Dust of Chimneys of Cement Plant Furnaces at Al-Fuhays"]

[Text] It has been decided that the Cement Works Company is to install instruments to measure dust coming out of chimneys of the cement plant furnaces at Al-Fuhays, and other instruments for the same purpose in areas surrounding the plant.

Dr Jamal al-Sha'ir, minister of municipal and rural affairs, said that he had also decided that filters be installed for the dust which comes out of the furnaces, within a period not later than the end of the year 1982. Also records will be maintained of the readings of the dust-measuring instruments, in order to continuously keep track of the effect of the dust.

Dr al-Sha'ir explained that these decisions and recommendations were made at a meeting held under his chairmanship the day before yesterday. The director general of the Drinking Water Institute; representatives of the ministries of health, commerce, industry and agriculture, and of the cement company; the mayors of al-Fuhays and Mahis; and the assistant director for the environment at the ministry of municipalities attended the meeting.

Dr al-Sha'ir said that the ministry, in dealing with the matter of pollution in the municipalities of al-Fuhays and Mahis from the dust coming out of the cement plant chimneys, was acting out of concern to protect the environment and the health of the citizens of the two municipalities.

Dr al-Sha'ir also said that it had been decided that the cement company's health clinic should have special cards for every plant worker. On it would be recorded the results of comprehensive routine medical examinations, and any other medical examinations, so that the effect of the dust on the workers be observed.

It was also decided to accelerate the purchase of a water-purification unit, at the plant's expense, so that it may be installed by the end of next



August. Also, the company is constructing a big new water well, with the object of providing the maximum possible quantity of water to the inhabitants of Al-Fulayy and Bahis.

It was also decided at the meeting that the Al-Fulayy company should refrain from exploiting quarry areas near the town in order to improve the environment and embellish the city.

The Committee has also advised the company to allocate an annual sum to the municipalities of Al-Fulayy and Bahis, as a contribution by the company for the improvement of municipal public services.

It was also decided to accelerate the construction of the health center which will be established at al-Fulayy.

3512

END 1000

HIGH POLLUTION LEVELS FOUND IN NATION

Jiddah ARAB NEWS in English 22 Mar 80 p 2

[Text] Jeddah, March 21--An official report just issued indicates a high level of air pollution in the Kingdom's major cities, and recommends continuous monitoring in order to characterize problem areas and set ambient standards.

The 1977 report of the General Directorate of Meteorology, of the Ministry of Defense and Aviation published this week, said that measurements and monitoring indicated that significant pollution levels were already present in many areas. During the period from March 16, 1977 through April 1, 1977 ambient air pollution monitoring measurements were conducted in several areas of the country.

The measurements were made in major population centers of Jeddah, Riyadh and Dhahran. Studies also were conducted near the proposed industrial areas of Jubail and Yanbu. The measurements made included continuous monitoring of sulfur dioxide, oxidants, carbon monoxide, hydrogen sulfide, nitric oxide, and total suspended particulates.

"Results indicate that significant pollution levels are already present in many areas. The downtown areas of major population centers exhibit carbon dioxide levels which average 10 to 20 parts per million with peaks higher than 50 ppm during period of traffic congestion.

Sulfur dioxide levels are consistently in the range of 25 to 50 parts per billion, but levels as high as 90 ppb were found downwind of the Ras Tanura refinery in the small town of Safwa. Oxidant levels as high as 0.35 ppm were also recorded in this area, and in the town of Jubail oxidants peak values as high as 0.55 ppm were found."

The report said it was difficult to assess the levels of oxides of nitrogen and hydrogen sulfide since they were commonly at the lower end of sensitivity of the monitors used. Total suspended particulates were also high. The highest recorded was 967 per cubic meter south of Riyadh. It must be noted, the report said, that much of the particulate is in the form of wind blown dust and sand.

For test purposes the directorate chose a few sites in Jeddah. On March 17, 1977 the site was downtown near Said Stores, King Abdul Aziz Street. The temperature was 24C, relative humidity 63% at 1314 hours. Very high carbon dioxide levels were measured.

On March 19, 1977 south of Jeddah at the quarantine, on Mahjar Road, no significant levels of carbon dioxide were found but very high suspended particulates.

Significant levels of carbon dioxide were found in downtown Riyadh during the same week due to heavy traffic in the area. And in the Riyadh airport neighborhood low levels were indicated except for some high carbon dioxide peaks. Manual readings were taken from the ozone monitor digital readout which indicated some levels of significance.

Jubail recorded the highest levels of oxidants at 0.551 ppm. All other values were low except for several high carbon dioxide peaks. At Safwa the highest sulfur dioxide level was recorded at 90 ppb. Ozone was also relatively high.

CSO: 5000

MINISTERIAL COMMITTEE STUDIES DROUGHT AREAS, SEEKS RELIEF MEASURES

Wallo Administrative Region

LD181930 Addis Ababa Domestic Service in Amharic 1700 GMT 18 Apr 80

[Text] The special ministerial committee set up by the revolutionary government has toured drought-stricken areas in the Wallo Administrative Region to assess the situation before taking the necessary measures to combat the drought and recommending to the government possible ways to handle the problem at government level.

The ministerial committee paid inspection visits to five provinces in the Wallo Administrative Region. The committee, headed by Comrade Brig Gen Taye Tilahun, minister of the interior, visited the drought-stricken provinces of (Awea), (Kalu), Amba El, (Yeju) and (Raya Kobo) 14-16 April 1980 together with the region's chief administrator.

After its tour of the five provinces the committee held wide-ranging talks in the town of Dase, the regional capital, and issued instructions on how to deal with the problem. The ministerial team thanked the regional committee set up to help drought victims for its efforts and urged the members to continue their drive to alleviate the drought problem before it gets out of hand.

The ministerial committee directed that relief coordinating committees be set up at regional, provincial and district levels. They are to comprise representatives of public and government organizations and be headed by administrators. The ministerial committee directed that relief supplies of food be sent to drought-stricken provinces on an emergency basis. The ministerial committee ordered that the drought victims be given the necessary medical care and instructed the competent organizations to render all possible assistance to drought victims who have left their home areas and gone to the highlands in search of pasture and water.

According to a report by the relief and rehabilitation commission, more than 780,000 people are affected by drought in Wallo Administrative Region.

The ministerial committee inspected an estimated 70,000 head of cattle which have moved to the highland areas of (Chafa) from lowland areas. During its inspection tour of the provinces the committee learned that many cattle have died in the drought. Thousands of sheep and goats, as well as horses, mules and other pack animals, have also been lost. Owners of cattle and other animals are prepared to cut prices but can find neither government nor private buyers. Cattle are still dying off.

The ministerial committee has now gone to Tegre Administrative Region for a similar study tour.

#### Tegre Administrative Region

LD201728 Addis Ababa Domestic Service in Amharic 1030 GMT 20 Apr 80

[Excerpts] The special ministerial committee formed to tour and study the situation in the drought-affected areas in Ethiopia this week toured Tegre Administrative Region. The committee, headed by Comrade Brig Gen Taye Tilahun, minister of the interior, inspected the drought situation in the Inderta and Aksum provinces of the Tegre Administrative Region, accompanied by the chief administrator of the Tegre Administrative Region, Comrade Maj Mulugeta Hagos. The committee was also briefed on the difficulties being experienced in the other six provinces as a result of natural disasters and man-made problems by the chief regional administrator and the provincial administrators.

During its 2-day study tour of Mekele and other places beginning on 10 April the ministerial committee was able to observe that many people are suffering serious problems in a number of areas. The committee also held talks with members of 15 farmers associations who are camped at Hibrete Selam, 20 km from Mekele, seeking food and assistance. The representatives of Adigrat Town and its environs told the committee that large numbers of cattle have died from lack of fodder caused by the drought and that the people also face problems. They consoled the farmers by telling them that the revolutionary government is making the necessary efforts to help the broad masses who are facing difficulties caused by natural disasters and man-made problems and that they will continue to render the maximum assistance.

The regional administrative office also reported that sabotage by counter-revolutionary, antipeople and antiproduction bandits of the distribution of high-grade seed and fertilizer and of technical advice of agricultural experts to peasants are additional causes. Moreover the crops planted in the 1979/80 season largely failed owing to light rainfall, and what little survived was destroyed by grasshoppers. The administrative office said that owing to these problems, the region is affected by famine, which has caused extensive damage.

After ending its tour, the special ministerial committee, held lengthy discussions on ways of helping the drought victims promptly, and of finding a

lasting solution to the problem. The committee decided that before 40,000 quintals arrive from Addis Ababa within 8 or 10 days of 19 April, the 35,000 quintals of staples now available at the region's grain marketing organizations and offices of the relief and rehabilitation commission be promptly distributed to the people affected. It also directed the regional administrative office to register the drought victims and affected animals and report to the water development office so that sufficient water can be supplied.

The special ministerial team also directed the region's relief coordinating committee, yet to be established, to survey for additional wells, work out priorities and to promptly submit its report to the water development office. The team also noted that the problem is now beyond the capacity of the relief coordinating committee, as Tegre Region has been afflicted by drought since the 1971/72 season.

The team also called on the region's health organization to give health lessons at relief centers to prevent the breakout of communicable diseases in situations of overcrowding. It also urged the relief and rehabilitation commission to spare no efforts in supplying medicines for animals and to ensure that all dead animals are promptly buried. It requested the relevant government organizations to find ways of buying the cattle before they all die of thirst and ordered the chief administrator to make sure that the Mekele abattoir association, which is not functioning, resumes operations.

#### UN Aid Sought

LD201730 Addis Ababa Domestic Service in English 1015 GMT 20 Apr 80

[Text] Comrade Shimelis Adugna, commissioner for relief and rehabilitation, returned to Addis Ababa today from New York. The RRC [relief and rehabilitation commission] commissioner was attending a meeting of the UN Economic and Social Council. The meeting considered the drought in Ethiopia following a report on the situation presented to it by Comrade Shimelis. The meeting, which also heard reports on the same subject from the UN disaster relief coordinators, unanimously passed a resolution last Wednesday appealing to governments and private and intergovernmental organizations to maintain and increase aid to Ethiopia and relief assistance to the drought-stricken areas of the country. Comrade Shimelis also held lengthy talks on the drought situation with UN Secretary General Kurt Waldheim. The RRC commissioner said that the UN had decided to send a team to Ethiopia to assess the effects of the drought and the emergency relief assistance required. He had earlier visited Geneva where he had talks with the UNHCR. Commissioner Shimelis said the UNHCR had assured him he would follow the matter closely and take the necessary measures in the face of the false claims the expansionist Mogadishu regime was making in the name of refugees to get support from the UNHCR.

# FIRES, VANDALS DESTROY EXOTIC TREES

Lusaka TIMES OF ZAMBIA in English 17 Apr 80 p 5

[Text]

**FIREBUGS and vandals set alight more than 200 hectares of pine and eucalyptus trees of the Industrial Plantations near Kalulushi last year, said extension officer, Mr Aaron Banda.**

Mr Banda said of a total of 68 fires which gutted the forests mainly on the Copperbelt, only 20 per cent were accidental while the rest were deliberately started.

In all 294 hectares of exotic trees were damaged through fires started by charcoal burners and honey hunters.

To end wanton destruction of the forests, the Industrial Plantation plans to launch an anti-bush fire campaign through the mass media before the dry season starts.

"We intend to seek assistance from Party leaders in villages during our campaign which will include showing films on the effects of bush-fires to forests," he said.

Mr Banda said the demand for hard and soft wood for industrial and domestic use had increased because indigenous trees were gradually being depleted in most towns on the Copperbelt.

To meet the demand, the Industrial Plantation was planting 4,000 hectares a year and it was hoped by the year 2000 there would be over 85,000 hectares of exotic trees in the country.

Over the past decade about K40 million had been ploughed into the scheme with the Government meeting 70 per cent of the total expenditure, 22 per cent by the Commonwealth Development Corporation through the World Bank and the rest generated within the country.

CSO: 5000



CEMENT FIRM LACKS MEANS TO CONTROL POLLUTION

MILWAUKEE JOURNAL OF ZAMBIA in English 17 Apr 80 p 2

(ZINA)

**CHILANGA Cement** has no financial resources to rectify the air pollution problem, a company spokesman said in Lusaka yesterday.

Air pollution by the company has continued to disrupt experiments at Mucosi Makulu Research Station while residents of Ndola's Liwa suburb have complained of cement dust from that town's factories which is polluting the area.

On the Ndola problem, the company spokesman said Chilanga was concerned as everybody else was to control the emission of dust from its kilns but that lack of money had made it impossible for the company to solve the problem.

"Chilanga Cement does not have the financial resources to rectify the situation immediately," said the spokesman.

The company has been given up to July by Ndola council to rectify the situation or have the plant closed down by court order under the Public Health Act.

The spokesman said although the firm was eager to do something about the dust, it would need more time than that given by the council.

Ndola council understands Chilanga Cement's liquidity

problem and has been very helpful on this matter in the past as indicated by its willingness to postpone obtaining a court order to have our Ndola factory closed," he said.

He explained that the company had taken steps in the past to control the outflow of dust.

The firm has ordered special filters, the electrostatic precipitators, to eliminate the emission from the kilns.

Installation of the filters already in the country, would cost about K1 million. This is considered a substantial figure in view of the company's present economic position.

The spokesman appealed to Liwa residents and Ndola council to bear with Chilanga Cement as closing the factory would have serious consequences.

"Not only would many workers be laid off, but the closure could bring a lot of difficulties in the supply of cement," he said.

He said people should not overreact to the dust as the emission was harmless to human beings, animals and plants.

The dust contains calcium carbonate, potassium sulphate and sodium sulphate which enrich the soil.

'PRAVDA' REPORTS DNEPRODZERZHINSK POLLUTION CONTROL PROGRAM

LD030703 Moscow PRAVDA in Russian 25 Mar 80 p 2 LD

[Report by PRAVDA correspondent V. Cherkasov under the rubric "We Report the Details": "Protecting River and Sky"]

[Text] Dneprodzerzhinsk--The USSR Academy of Sciences Presidium and Dneprodzerzhinsk Dzerzhinsk have approved a comprehensive plan of research and experimental design work to improve the city environment. You can see this city on the banks of the Dnepr from a great distance--from the window of your railroad car, bus or aircraft or from the deck of your boat. The chimneys of mighty plants, a sea of lights at night and everything that accompanies the life of a major industrial center. When there is no wind, smoke, gas and dust hang over the enterprises.

What measures are being taken and planned to eliminate the plumes over chemical enterprises, remove the smoke over open-hearth furnaces and purify effluents? The Dzerzhinskiy plant is planning to introduce a closed water circulation system and is creating a dirty water recycling system for the 350 rolling mill and other sectors. It is planned to spend \$6 million on constructing all these water conservation installations during the 5-year plan. And the results are already apparent. In the last 3 years the discharge of effluent into the Dnepr has been reduced by 100,000 cubic meters per day. The commissioning of installations for the biological purification of effluent will be particularly important for the city. Several open-hearth furnaces at the Dzerzhinskiy plant have already stopped smoking, and soon all its chimneys will be reliably protected by caps from producing harmful discharge. "This comprehensive plan is the first experiment in our country and the republic in which scientists in research institutes and VUZ's and also party and soviet organs and industrial personnel have simultaneously been involved in solving the extremely important task of protecting the biosphere in a major industrial center," V.N. Poturayev, corresponding member of the Ukrainian SSR Academy of Sciences, says. "In the future it is planned to use the methods and principles developed here in solving conservation problems in other cities in the country."

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USSR

BRIEFS

SOUTHEAST TADZHIKISTAN EARTHQUAKE--Dushanbe, 10 Apr, TASS--An earthquake took place today at 5:25 a.m. Moscow time in the mountains of south east Tadzhikistan in Soviet Central Asia. According to the "Dushanbe" seismic station, its force in the epicentre, which is one hundred and fifty kilometres away from the capital of Tadzhikistan, reached five points on the twelve point scale. There have been no human losses. [Text] [LD101420 Moscow TASS in English 1332 GMT 10 Apr 80 LD]

CSO: 5000

ERRATUM: This is a corrected version of article which appeared in JPRS 75483, 11 April 1980, No. 248 of this series, pp 111-114. Greenland should have been Grenland throughout entire article.

NORWAY

#### ENVIRONMENTAL AGENCY REPORTS ON GRENLAND AIR POLLUTION

Oslo ARBEIDERBLADET in Norwegian 4 Feb 80 p 6

[Article by Arne Olsen: "Norway's Ruhr"]

[Text] Porsgrunn: Industry or us? Jobs or clean air?

Concern is spreading in Grenland after repeated leaks and gas emissions from industry in the area. Grenland's most important and profitable part has demonstrated its most frightening side during the past weeks.

The escape of sulfur dioxide from Union in Skien has been many times the recommended limit. Asthmatics and people with respiratory diseases were not able to move about outdoors. But healthy people also noticed the emission. Coughing, nausea, headaches, runny noses, and sore throats were experienced.

At Rafnes five workers had to be given oxygen after a chlorine leak. The stinging aroma of chlorine was noted more than 1 mile away. Also, Norsk Hydro's factories on Heroya in Porsgrunn have had lesser accidents.

The government's Pollution Control Agency (SFT) at Porsgrunn released some frightening statistics on the emissions in the air at Grenland: 12,100 kg of sulfur dioxide per day are emitted from Grenland's industry. That amounts to 4,416 thousand kg per year! Or 500 kg per hour, if you prefer.

At Brevik and at Dalen near Brevik clothes must go through the washing machine once, hung until dry, and then washed again. The reason is the large amount of dust emission from cement production at Norcem.

Washing in this area would have not less than 547.5 tons of dust exposure if it hung out all year.

Or, if we imagine a warm summer day with good drying, when the wash needs a couple of hours before it can be brought in, 125 kg of dust is emitted from Norcem during this time. In addition, increased maintenance is required on homes and automobiles.

The Union Brug recovery plant at Skien has been the center of attention in recent weeks. SFT has set a limit of 3.5 kg of sulfur dioxide per hour, but the emission has been far greater, so great that on Wednesday the factory was ordered to stop production of cellulose at the recovery plant.

The Poragrunn factories on Heroya are the greatest polluters on an annual basis.

During a 24-hour period at these Hydro installations the following results are obtained according to SFT's measurements: 3.4 tons of dust, 2 tons of sulfur dioxide, 2 tons of nitrous oxide, 2.5 tons of chlorine and hydrochloric acid, 0.8 tons of vinyl chloride, and 1 ton of ammonia.

All this goes out into the atmosphere during the course of 24 hours. In addition 1.2 tons of nitrous oxide is formed by combustion.

But large amounts of waste from Hydro's production are sent out into the water.

These include 10 kg of mercury, 1,040 kg of chlorinated hydrocarbons, and 3,650 kg of soot per year, and 39,000 human body equivalents of phosphorous and 1.3 human body equivalents of nitrogen compounds.

But Things Are Improving...

Poragrunn: paradoxically enough--the large petrochemical installations at Rafnes and Saga in Bramble have led to a reduction in the measurable pollution in Grenland.

As a result of the petrochemical concessions, strict pollution control orders were issued to the existing industries in the area. Funds spent in the last 5 or 6 years for pollution control and plant modernization amount to 600 million kroner.

Especially obvious are the emissions from the largest polluter in the area, Norsk Hydro's factories on Heroya in Poragrunn. In 1968 the factories released over 18 tons of sulfur dioxide per day, and at the beginning of 1979 this amount was reduced to only 2 tons.

Scientist Leif Stige at SFT in Poragrunn said, "We have noted a marked improvement, but the negative results of pollution are still so great that we cannot be satisfied with the situation. The acute situation with Union in Skien during the recent weeks shows the importance of our watching the situation closely, and we will continue to do that."

Advantages

The strict environmental orders given to Grenland's industries have caused protests from the responsible business leaders.

Today the protests have become still. In several cases it has been proved that modernizing production has economic advantages, not the least of which is that production has become more efficient in these energy critical times.

#### Grenland Smog

The most conspicuous result of Grenland's pollution is in the air, in Grenland smog.

Dense smog which reduces visibility to zero on the roads, but even more serious, on the sea. The area has much sea traffic, and the channels to the petrochemical plants are considered dangerous.

What happens is that the sulfur dioxide is transformed to sulfates, and together with natural mist and other pollutants creates smog.

Measurements will now be taken to determine how much of the smog is caused by natural conditions and how much by pollution.

#### Damage to the Forest

At the beginning of the 1970's there was alarm when large belts of forest near the Porsgrunn factories turned brown and the needles fell from the evergreen trees.

Without a doubt the strong concentrations of sulfur dioxide were a contributing factor.

Now it appears that this situation has stabilized, even though repeated dry summers and resulting bark beetle attacks have caused large financial losses for the forest owners in Telemark, perhaps most in Bramble.

#### Dangerous to Health

The big question is obviously what are the health related effects of 10 years of pollution.

A comprehensive health study was carried out last fall, but the results will not be published before the summer vacation.

Leif Stige said, "We have, however, no grounds for declaring that pollution has affected health conditions at Grenland."

One phenomenon that is being especially watched for is photochemical smog resulting from petrochemical plants.

This is characterized by odor, mist, attack on the mucous membranes and throat, and forest damage.

This has not been noted so far, but SFT has made measurements of high concentrations of ozone on warm days, one of the indications of the formation of photochemical smog.

"In many ways we are the watchdogs of Grenland industry, but we only advise the politicians. They are the ones who must give orders to the businesses within the framework of the best available technology, the total pollution situation in the area, and emission limits established abroad," said Leif Stige of SFT.

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## SELECTIVE LIST OF JPRS SERIAL REPORTS

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WORLDWIDE REPORT: Nuclear Development and Proliferation  
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